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Science in the Field

High School: Grades 9-12 Program Suggestions

Our High School programming is all about becoming field scientists to investigate biodiversity and trends. Below is a list of potential programs for grades 9-12 with *suggested* locations and seasons for each program. Please keep in mind that all programs can be modified to fit your school's curriculum goals and the learning interests of your classroom. If you are unable to come to Manomet, we can always find a way to bring programming to your school in-person or virtually!

We recommend combining **Songbird Science** with one of our **Stewardship Nature Walks**; however, programs can be mixed and matched in any way.

	Program Description	Location			Season	
Songbird Science	Students will take on the role of banding lab scientists as they learn how we use mist nets and bird banding to study birds! They'll retrieve and identify a realistically sized and weighted model bird from a net and weigh it on a scale to assess health and migration status. We'll discuss how bird form relates to function, with a focus on feeding and migration strategies. Students will use a simplified banding code to 'band' their bird, or to interpret a band to learn more about migratory paths. Finally, student scientists will interpret graphs showing population trends based on Manomet's 50+ year banding dataset, report to their peers on population change over time, and construct explanations for these trends based on what they have learned about bird biology, migration, and environmental stressors. We'll discuss how climate has changed over time, and relate this environmental information to the ecological needs of different birds, particularly during key life history moments such as migration and nesting. We'll also discuss how human activity affects bird populations both here in Massachusetts and elsewhere along their migratory paths, and ways that we can support migratory birds. **The experience will culminate with a visit to the Manomet banding lab* - in person or virtual – to meet some live birds and see banding in action!**	Manomet	Greenspace	Classroom	Fall	Spring
Biodiversity Study	Students will perform plot studies to calculate biodiversity in an area. In small groups, students will section off a plot of land in which they will record species present, the number of individuals of each species, and then use this information to calculate biodiversity. Students will use field guides, provided resources, and scientific tools to ensure accurate data collection and measurements. After assessing their individual plots, students will compile their data as a class to calculate total biodiversity. Students will consider why areas of higher biodiversity are considered healthier than areas of low biodiversity and how biodiversity contributes to the resilience of an environment. As a final exercise, students will share ways in which they can encourage increased biodiversity in the area.	Manomet	Greenspace	Classroom	Fall	Spring
Milkweed Management	Students will become land stewards and help to manage milkweed at Manomet! Milkweed is an important plant for monarch butterflies and many other organisms. Students will learn about pollinators and the many ways that plants and pollinators depend on one another, and about the ongoing management of milkweed at Manomet to encourage biodiversity, provide food to birds, and contribute to monarch conservation. We will go over different land management practices such as fire and grazing and consider how mowing helps to mimic these practices, while also providing additional challenges. Students will gather data on milkweed abundance and distribution within experimental plots to help us measure whether our adaptive management strategies are working. In the fall, students will use their data to calculate the total number of seed pods and seeds in a plot and compare those data to baseline numbers from previous years. Students will assess the success of Manomet's milkweed management strategies, discuss environmental influences that might affect milkweed survival in the future, and make recommendations for future management strategies at the study site. *Optional: it may be possible to arrange a visit with a local beekeeper as part of this activity.*	Manomet	Greenspace	Classroom	Fall	Spring
Climate Lab!	Climate change often conjures up images of hotter summers – but how does it change ecosystems? In this activity, students will participate as climate scientists to directly monitor climate change through the study of phenology – the timing of seasonal changes. Students will measure leaves of plants to determine the precise timing of seasonal changes in leaf size, number, and color. Over time, these data can be used to monitor long-term changes in the timing of important ecological events such as leaf out. Students will discuss the different factors that may impact leaf out and leaf growth rates, and the potential for ecological mismatch – changes in the relative timing of plant growth and the emergence and feeding cycles of insects and birds that depend on them. We will set up frass traps at the beginning of the lesson to explore caterpillar abundance in the plants we are observing. In the fall, students will also consider the availability of fruiting bodies and document berry abundance of native plants. We will make connections to food and resource availability, plant-animal interaction, and biodiversity. This is an ideal long-term monitoring activity – try it out at Manomet, and then work with us to set up a Climate Lab monitoring site on school grounds!	Manomet	Greenspace	Classroom	Fall	Spring

*The banding lab operates in the Spring and Fall. If you are unable to schedule your program during these times, we can provide a link to a pre-recorded visit to the banding lab so students can see banding in action!

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High School: Grades 9-12
Songbird Science and Stewardship Nature Walk
MA STE/NGSS Standards Alignment

Manomet Programs and MA STE/NGSS: Manomet education programs can be used to support student progression toward a wide range of Massachusetts Science and engineering/NGSS performance expectations. Below for each grade level range, we provide a list of relevant Performance Expectations, Science and Engineering Practices, Disciplinary Core Ideas, and Cross-Cutting Concepts covered. All Manomet education programs are customizable; teachers are encouraged to reach out to share their curricular priorities.

Performance Expectations Supported:

HS-ESS3-3. Illustrate relationships among management of natural resources, the sustainability of human populations, and biodiversity.

HS-LS2-1. Analyze data sets to support explanations that biotic and abiotic factors affect ecosystem carrying capacity.

HS-LS2-2. Use mathematical representations to support explanations that biotic and abiotic factors affect biodiversity. (Stewardship Nature Walk only)

HS-LS2-6. Analyze data to show ecosystems tend to maintain relatively consistent numbers and types of organisms even when small changes in conditions occur but that extreme fluctuations in conditions may result in a new ecosystem. Construct an argument supported by evidence that ecosystems with greater biodiversity tend to have greater resistance to change and resilience.

HS-LS2-7. Analyze direct and indirect effects of human activities on biodiversity and ecosystem health, specifically habitat fragmentation, introduction of non-native or invasive species, overharvesting, pollution, and climate change. Evaluate and refine a solution for reducing the impacts of human activities on biodiversity and ecosystem health.

HS-LS4-2. Construct an explanation based on evidence that Darwin's theory of evolution by natural selection occurs in a population when the following conditions are met: (a) more offspring are produced than can be supported by the environment, (b) there is heritable variation among individuals, and (c) some of these variations lead to differential fitness among individuals as some individuals are better able to compete for limited resources than others. (Stewardship Nature Walk only)

		Songbird Science	Stewardship Nature Walk
Science and Engineering Practices	**Developing and Using Models**	Students will manipulate and use model birds to identify the birds and to determine their health status. Students will interpret scientific models such as graphs and diagrams to make predictions about bird health, population trends and ecological stressors.	
	Analyzing and Interpreting Data	Students will analyze and interpret songbird population trends to understand population change overtime.	Students will analyze and interpret the data they collect to better understand ecological phenomena. They will also consider limitations of the data analysis related to experimental design.
	Constructing Explanations	Students will use datasets provided and background knowledge to make claims about population trends, bird health, ecological stressors and how they are related.	Students will use data collection and observations to make claims regarding the relationship between organisms and their environment.

	Asking Questions and Defining Problems		Students will ask questions that arise from careful observations during data collection to identify additional questions that can be investigated within the scope of the environmental monitoring sites.
	Using Mathematics		Students will calculate biodiversity based on species richness and species evenness (Biodiversity Study), or milkweed seed abundance (Milkweed Monitoring). Students will then evaluate their findings.
	Engaging in Argument from Evidence		Students will use share the results with their peers using scientific evidence to support their ideas.
	Communicating Information	Students will interpret data and observations to clearly communicate findings to their classmates. Students will consider how their data and observations relate to patterns and phenomena overtime and share their conclusions with each other.	
Cross-Cutting Concepts	**Structure and Function**	Students will make inferences about bird behavior based on their physical adaptations. Students will also make inferences about the adaptations required for successful migration.	
	Cause and Effect	Students will compare population trends among their peers, who have different bird species, to examine why population changes are not the same for all species studied at Manomet. Students will examine why changes in systems may not have equal effects on populations.	Students will study environmental management strategies and observe how systems can be designed to cause a desired effect based on data collected and additional provided resources.
	Scale, Proportion and Quantity	Students will weigh bird models to describe the weight of their bird models and relate those measurements to bird health and ecology. Students will study population trends at Manomet and consider how these trends translate to larger populations.	Students will investigate environmental monitoring sites and examine the relationship between the plots they are studying and how they relate to larger systems regionally or globally.
	Patterns		Using relative biodiversity indexes, students will examine patterns of organism abundance by comparing data and findings with their classmates.
	Stability and Change	Students will analyze data to construct explanations of how environmental factors may change and impact populations, organism interactions, and entire ecosystems. Students will examine short term changes, such as weather, and long-term changes, such as climate change, and the impacts that these changes have on ecosystems and biodiversity.	

Disciplinary Core Ideas Addressed	
	LS2.A: Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.
	LS3.B: Environmental factors, in addition to sexual reproduction and mutations, also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus, the variation and distribution of traits observed depends on both genetic and environmental factors.
	LS4.B: The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.
	LS4.C: Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost.
	LS4.D: Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, over exploration, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining both biodiversity also aids humanity by preserving landscapes or recreational and inspirational value.